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AUTHOR	Meyer, Janice D.; Barufaldi, James P.
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ABSTRACT

The purpose of this study was to investigate the role of the Texas Regional Collaboratives (TRC) professional development program in science teacher renewal and retention. Eighty-five science teachers who were members or former members of the TRC for Excellence in Science Teaching participated in the survey. The characteristics of teachers involved in a sustained TRC professional development program were examined. Why teachers join the TRC program, why they remain in the program for many years, why they leave the program, and factors impacting science teacher renewal are discussed. (KHR)

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The Role of Sustained Professional Development in Science Teacher Renewal and Retention

Janice D. Meyer
Science Education Center
The University of Texas at Austin
jmeyer@mail.utexas.edu

and

James P. Barufaldi
Science Education Center
The University of Texas at Austin
jamesb@mail.utexas.edu

http://regcol.edb.utexas.edu

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THE ROLE OF SUSTAINED PROFESSIONAL DEVELOPMENT IN SCIENCE TEACHER RENEWAL AND RETENTION

In the next five years, there will be a national shortage of almost 2 million teachers (Olsen, 2000). Texas alone is predicting a shortage of approximately 40,000 teachers for the 2003-2004 school year (Texas Education Agency, 2002). In both cases, the majority of the vacancies are in math and science. Some of the vacancies are due to retiring teachers but most are due to teachers leaving the field (Ingersoll, 2001). What can be done to keep teachers, especially science teachers, in the teaching profession?

The literature provides four ways to retain science teachers. The first is to improve teaching conditions (Ingersoll, 2001, Schorling, 2000, Olsen, 2000, and Cohen, Higgins, & Ambrose, 1999). The second is to pay teachers enough money so they can adequately live and survive in today's economy (Cockburn, 2000, Cohen, Higgins, & Ambrose, 1999, and Espinet, Simmons, & Atwater, 1992). Mentoring is considered a third method of retaining science teachers (Luft, Roehrig & Patterson, 2003, Luft & Cox, 2001, and Olsen, 2000). The last and most promising way to retain science teachers is professional development (Cockburn, 2000, Olsen, 2000, Cohen, Higgins, & Ambrose, 1999, Hancock, 1998, and Loucks-Horsley, et.al, 1998).

Effective professional development programs have been linked to retaining and renewing science teaching. Loucks-Horsley, et.al, (1998) describe seven principles found in effective professional development programs for science teachers. These principles promote and support overall systemic reform, rather than just teacher reform (Loucks-Horsley, et.al 1998). An effective professional development program for science teachers is: 1) driven by a well-defined image of effective classroom learning and teaching; 2) provides opportunities for teachers to build their knowledge and skills; 3) uses or models the strategies teachers will use with their students; 4) builds a learning community; 5) supports teachers to serve in leadership roles; 6) provides links to other parts of the education system; and 7) is continually assessing themselves. These seven principles described by Loucks-Horsley, et. al. are also supported in numerous other articles (Garet, M., et.al, 2001; Supovitz & Turner, 2000; Kennedy, 1999; and Darling-Hammond, 1997) on effective professional development for science teachers. By incorporating the qualities of effective professional development, a professional development provider can create a more meaningful experience for all involved and address reform efforts called for by the science education community as well. Although effective professional development has been cited as the most promising way to retain and renew science teachers, there is very little research in the area that describes effective strategies. Is there a model for science teacher professional development in existence that is effective in renewing and retaining science teachers?

Context

The Texas Regional Collaboratives for Excellence in Science Teaching – An Effective Model

What are the characteristics of an effective science professional development program that meets the principles of effective professional development and also addresses the needs called for by the science education community? The Texas Regional Collaboratives for Excellence in Science Teaching (Texas Regional Collaboratives or TRC) provides an example of one such program.

The Texas Regional Collaboratives is a statewide professional development program housed in the Science Education Center at the University of Texas at Austin. "The mission of the TRC is to provide Texas science teachers with ongoing support systems of sustained, high-intensity professional development, to assist Texas science teachers in implementing the Texas Essential Knowledge and Skills through upgrading their knowledge of content and pedagogy and to engage ALL students in interesting, relevant, experiential, and meaningful science learning experiences"(TRC, 2003). During the 2001 - 2002 school year, the Texas Regional Collaboratives provided over 700 science teachers, from all grade levels and diverse socioeconomic schools, with over 100 contact hours of professional development. For over ten years, the TRC has been providing effective professional development to science teachers. In 2000, the work of the Texas Regional Collaboratives was honored by being inducted into the Texas Science Hall of Fame as an exemplary education program that promotes science in Texas.

There are twenty collaborative sites that cover the state of Texas. As stated by Jbeily and Barufaldi (1998), each Texas Regional Collaborative site subscribes to important elements of professional development such as, 1) commitment to collaboration, high standards, alternative assessment, experiential learning, and constructivism, 2) the philosophy of bringing the real world into the classroom and, 3) integration of instructional and communication technology into their program. Each collaborative is a partnership of local businesses, school districts, region service centers, and universities who are committed to science education reform (Barufaldi, 2000). Besides partnering with local agencies, each collaborative is supported through business partners at the state and national levels. Major partners include: the National Science Foundation, Texas Education Agency, CASIO Inc., Delta Education, ExxonMobil Education Foundation, Frey Scientific, Holt, Rinehart and Winston, Shell Oil Company Foundation, Southwestern Bell Corporation, and Toyota USA Foundation. These partners provide support through cost-sharing, in-kind contributions, and human resources to enhance the professional development programs of the

Texas Regional Collaboratives. Much of the success of the TRC can be attributed to the support of these funders and business partners.

The Texas Regional Collaboratives model of sustained professional development for science teaching is complex and multi-tired. The TRC model for professional development can be divided into three levels: the university level, the state office level, and the collaborative level. The TRC model is highly dependent upon the collaboration between the University of Texas at Austin, College of Education and Science Education Center (for more information on TRC model at the university level, please refer to Barufaldi, J.P., & Reinhartz, J., 2001). The university level provides support for the state office level of the professional development program (for more information on the TRC model at the state office level, please refer to Meyer, 2003). It is at the collaborative level of the Texas Regional Collaborative professional development model where the impact of the professional development on both teachers and students is observable.

Figure 1 shows the collaborative level of the TRC model of professional development for science teacher.

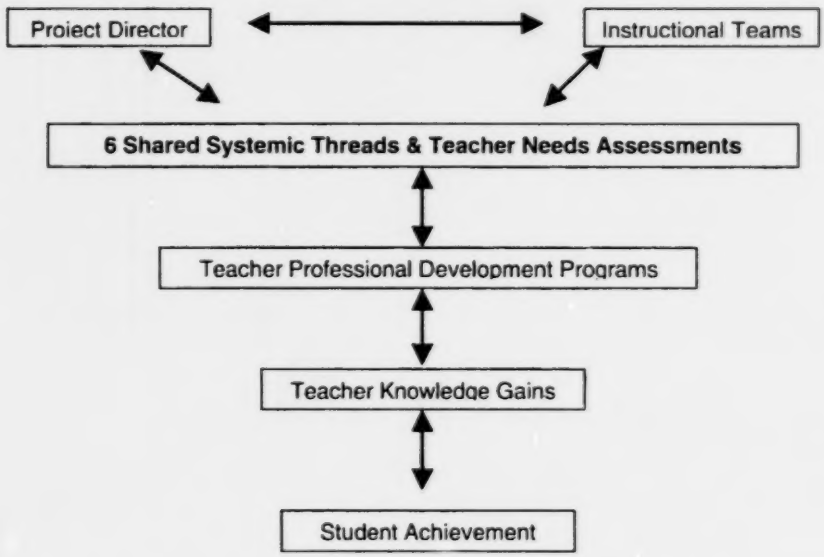

Figure 1: Collaborative Level of TRC Model

The Project Director oversees each collaborative and serves as the link between the activities at the collaborative site and the Texas Regional Collaboratives State office. The Project Director works with the Instructional Team, which is composed of scientists, master teachers, education service center instructional specialists, informal educators and science educators (Barufaldi & Reinhartz, 2001). The actual make up of the

Instructional Team varies from one collaborative to another based on the specific needs of that site. It is the Instructional Team that is responsible for providing collaborative members with over 100 contact hours of professional development. To ensure that the Instructional Team grows professionally as well, the TRC state office provides specific professional development opportunities to meet the needs of the Instructional Team (Barufaldi & Reinhartz, 2001).

The core of each collaborative and the unifying factor that makes the Texas Regional Collaboratives professional development model successful is the six shared systemic threads and teacher needs assessments. Having shared systemic threads in all of the collaboratives reinforces the shared vision of the TRC program. The six strands are: Scientific Literacy, Technology, Standards, Equity, Assessment, and Constructivism (Jbeily & Barufaldi, 1998). All twenty collaboratives use these strands to design their teacher needs assessments and professional development opportunities called Professional Development Academies (PDAs).

Some would think the easiest, most efficient method for a statewide professional development program would be to have a standardized "kit" of activities for all collaboratives. That would make sense if teachers and students in Texas were all the same. Texas, however, is one of the most diverse states, serving teachers who teach in every imaginable scenario, from rural, low socio-economic status, minority students to suburban, high socio-economic status, Anglo students. Texas teachers and students across the state have different needs. The Texas Regional Collaboratives has designed a model to meet these needs. Each year, needs assessments are administered to the participating teachers to determine those areas of science and pedagogy most needed by the teachers in that area. Therefore, the collaborative activities in the Region 16 Collaborative in Amarillo will differ from those of the University of Texas at Pan-American Regional Collaborative in Edinburg. This provides each collaborative with the flexibility to serve the needs of the teachers in their region while remaining within the framework of the six shared systemic threads of the vision of the Texas Regional Collaboratives.

There are two outcomes of the TRC professional development model. The first is an increase in teacher content and pedagogical content knowledge. Effective professional development programs develop teacher understanding of science concepts and pedagogy (Garet et.al, 2001; Rhoton & Bowers, 2001; Loucks-Horsley, et.al, 1998; NSES, 1996). Evaluation of the TRC program over the last ten years reveals significant gains in teacher content knowledge in science and pedagogical content knowledge (Fletcher, 2002). Texas Regional Collaboratives teachers report not only an increase in their understanding of science but also in their confidence in and understanding of the teaching of science (Meyer, 2003).

The second outcome of the TRC model is student achievement in science. In a recent survey of science professional development programs conducted by Kennedy (1999), only 10 of the 93 programs surveyed reported evidence of student learning as an outcome of teacher professional development. Texas is recognized for the high stakes student assessment it administers each year known as the Texas Assessment of Academic Skills (TAAS) test. Historically, science has not been an accountable content area in Texas. With the introduction of the new state accountability test, Texas Assessment of Knowledge and Skills (TAKS), in Spring 2003, students will be assessed as part of the accountability system in science at the end of grades 5 and 10 and will have to pass an exit level science test before they can graduate high school. For the last four years, the Texas Regional Collaboratives office in Austin has been assessing the impact of teacher professional development in science on teacher knowledge and student achievement by administering content specific tests to collaborative teachers and their students. Outcomes have been positive (see Fletcher, 2002 for details) and it is anticipated that students of TRC teachers will receive passing scores on the new TAKS tests.

To determine if this model is considered to be an effective professional development model for science teachers based on the principles described by Loucks-Horsley, et. al, (1998) a comparison was conducted of Loucks-Horsley's seven principles to the Texas Regional Collaboratives professional development program. The results are found in Table 1.

Table 1

Principles of Effective Professional Development for Science Teachers

Loucks-Horsley, et. al	Texas Regional Collaboratives
1. Well defined image	1. Six shared systemic threads
2. Teachers building knowledge and skills	2. Professional Development Academies
3. Provides models teachers use with students	3. Teachers trained as they would teach their students
4. Builds a learning community	4. Network with local teachers
5. Teachers in leadership roles	5. Science Teacher Mentors
6. Links to other parts of the system	6. Access to up-to-date state and national information as well as experts in science and science education
7. Continually assessing	7. Pre & Post assessment each year

Loucks-Horsley, et.al, (1998) state that an effective professional development program for science teachers has: a well-defined image, builds teachers' knowledge and skills, and provides teachers with models they would use with their students. The Texas Regional Collaboratives program provides these principals in numerous ways. The well-defined image, as discussed earlier, is the six shared systemic threads embraced by the entire collaborative. The TRC uses Professional Development Academies (PDAs) to assist teachers in building the science content knowledge and skills. During a PDA, teachers are "trained" as they would teach their own students. For example, if the PDA were a workshop using a Full Option Science System (FOSS) kit, the TRC teachers go through the kit as if they were the students in the classroom so they can experience the program as their students would. In addition, throughout the training the teachers also learn the related content and pedagogy necessary to teach the FOSS kit from the expert FOSS trainer.

The principles of effective professional development for science teachers also require a program to build a learning community, put teachers in leadership roles, and provide teachers with links to other parts of the education system. The Texas Regional Collaboratives model provides these principles as well. The learning community of science teachers extends beyond the local collaborative of teachers, across the 20 collaborative sites. This statewide learning community is supported each year through the Annual Meeting, which brings all the collaboratives to Austin, Texas for three days of networking and collaboration. The Texas Regional Collaboratives program is also known for establishing teacher leaders in the state. Numerous teachers have taken leadership roles in their region as well as in their district. Many of the collaborative teachers have served on statewide committees and the person serving in the ultimate statewide science education leadership role, Director of Science for the Texas Education Agency, is a former Texas Regional Collaboratives member. Through the building of a learning community and the building of leaders, the Texas Regional Collaboratives has also been able to provide teachers with links to other parts of the educational system. Through the networking opportunities, the TRC teachers stay current on national and statewide educational issues. Additionally, the TRC has provided Texas teachers with opportunities to meet nationally known scientists, such as Massachusetts Institute of Technology Physicist Tom Hsu and University of Wisconsin Chemist Bassam Shakhashiri.

The last principle of effective professional development as described by Loucks-Horsley, et.al. (1998) is that the professional development program is continually assessing itself. As previously stated, each year the Texas Regional Collaboratives program administers teacher needs assessments to determine the areas in which to focus the professional development. These teacher assessments are both formative and summative in nature and

assess the impact of the program on both the teachers and students involved in the TRC. Evaluation and assessment of the TRC program has revealed many interesting research areas. Numerous research studies are now underway to investigate the impact of the Texas Regional Collaboratives program on the teachers and students of Texas. The study presented here is one such research investigation.

The purpose of this study was to investigate the role of the Texas Regional Collaboratives professional development program in science teacher renewal and retention. The following research questions will be addressed in this study:

1. What are the characteristics of teachers who join a sustained professional development program?
2. What reasons do Texas science teachers provide for their decision to join the Texas Regional Collaboratives?
3. What reasons do Texas science teachers provide for their decision to remain in the Texas Regional Collaboratives?
4. What reasons do Texas science teachers provide for their decision to leave the Texas Regional Collaboratives?
5. How does the Texas Regional Collaboratives program impact the renewal and retention of science teachers?

Methods

Participants

Participants of this study were members or former members of the Texas Regional Collaboratives for Excellence in Science Teaching. Since every collaborative is structured differently, criteria for participation in the study were created. Project Directors were asked if their collaborative: 1) allows collaborative members to return year after year, and 2) does not require participants to be enrolled in a graduate program as part of membership. These criteria were used to ensure that teachers had flexibility in their collaborative membership and were not members only to obtain a graduate degree. Then the criteria for inclusion in the study were narrowed even further. If the collaborative had submitted their 2001-2002 Participant Data Forms and met the first two criteria, their members were selected. Of the 20 collaborative sites, six collaboratives were selected to participate in the study. From these six collaboratives, 185 teachers were sent the study questionnaire, 85 of these teachers were returning collaborative members while 100 were non-returning members.

Data Collection and Analysis

Demographic data necessary to compile the characteristics of teachers involved in sustained professional development were collected from the Texas Regional Collaboratives Participant Data Forms. Each year,

participants of the TRC program complete the Participant Data Forms that include information about their personal background as well as their school and classroom demographics. Each year the information requested changes due to changing requirements of the Texas Regional Collaboratives funders. Any additional demographic information that was needed was included on the study questionnaire.

The 185 teacher participants of the study were sent a questionnaire that contained three closed-ended questions in which they had to rank their responses, ten likert-scale questions and two open ended questions. The questions were designed based on responses from a previously administered pilot study as well as Texas Regional Collaborative evaluation reports. Two different questionnaires were designed, one for returning collaborative members and one for non-returning collaborative members. This design was to ensure necessary information was obtained from the two participant groups to answer the research questions of this study. (For a copy of the questionnaire, please contact the authors). At the end of July 2002, the questionnaire and a self-addressed return envelope were mailed to the home addresses of study participants and they were given two weeks to respond. Of the 185 teachers who were sent questionnaires, 60 responded, a 32.43% response rate. In addition, one-on-one interviews were conducted with a sub-set of those who responded to the questionnaire.

The three closed-ended questions from the questionnaire were analyzed and will be reported. Responses to each of the ranked questions were tallied and weighted means were determined to ensure the appropriate rankings were assigned. Teacher responses on the Texas Regional Collaboratives Participant Data forms were also tallied and percentages were calculated to determine the composite characteristics of a teacher involved in the Texas Regional Collaboratives professional development program. The responses to the likert scaled questions were used to support the findings from the open-ended questions and the one-on-one interviews with teacher participants. Interview participants were selected based on their responses on the questionnaire indicating their willing to participate in the interview. They were intentionally selected to include the different kinds of teachers who are current and former participants in the Texas Regional Collaborative program.

Findings

Characteristics of Teachers

This study examined the characteristics of teachers involved in a sustained professional development program. Demographically, a teacher who is involved in the Texas Regional Collaboratives sustained professional development program is a white (72.5%), female (83%). She holds a bachelors degree (76%) and was certified by a traditional certification program (83%). The TRC teacher teaches in a Title 1(72%) elementary school (49%), has

been teaching an average 13.4 years and has been involved in the TRC program for an average of 3.3 years. These demographics provide a composite profile of the teachers involved in the Texas Regional Collaboratives professional development program and are not reflective of the truly diverse nature of the TRC program. Appendix A contains a detailed breakdown of each demographic category and reveals the diversity of the TRC teacher participants.

Reasons for Joining, Returning and Leaving the Program

When asked their reasons for participating in the Texas Regional Collaboratives professional development program, the teacher participants ranked the survey responses in the following order (with the weighted average in parenthesis):

1. To enhance learning among my students (5.5)
2. Lessons/activities for the classroom (5)
3. To increase my science content knowledge (4.9)
4. The networking/collaboration provided by the collaborative (4.2)
5. Professional development/Continuing Education opportunities (3.7)
6. Equipment for my classroom (3.2)
7. Recommended by others (2.1)

The reasons provided by the returning teachers (N=42) for continuing their participation in the Texas Regional Collaboratives professional development program were similar to those for joining the program. The teacher participants ranked the survey responses in the following order (with the weighted average in parenthesis):

1. Lessons/activities for the classroom (3.6)
2. The networking/collaboration provided by the collaborative (3.3)
3. To stay current on statewide changes/TAKS information (3.1)
4. Professional development/Continuing Education opportunities (2.8)
5. Friendships/Fellowship found in the collaborative (2.7)

When the non-returning teachers (N=18) were asked why they discontinued participation in the Texas Regional Collaboratives program, they cited the following reasons (with the weighted average in parenthesis):

1. Family reasons (3.8)
2. Time involved with the collaborative (3.3)
3. Amount of work involved with the collaborative (3.2)
4. Changed teaching assignment to a subject other than science (2.9)
5. Personality conflicts with others in the collaborative (2)

These findings offer professional development providers insights into the kinds of teachers involved in sustained programs and their reasons for partaking in the professional development program.

Impact on Science Teacher Renewal and Retention

When asked if the Texas Regional Collaboratives program renewed their interest in science teaching, 1.8% of the responding teachers strongly disagreed, 3.6% disagreed, 12.7% were neutral, 32.7% agreed and 49.1% strongly agreed with the statement.

The ways the program impacted participants' renewal in science emerged from the one-on-on interviews as well as the open ended questions from the questionnaires. The TRC program impacts science teacher renewal by:

1. Building their confidence to teach science
2. Providing networking opportunities
3. Creating professional environments for teachers
4. Providing leadership opportunities
5. Providing current information on statewide educational issues
6. Providing classroom lessons and materials

When study participants were asked if they had considered leaving the teaching profession, 69.6% strongly disagreed, 17.8% disagreed, 5.4% were neutral, 1.8% agreed, and 5.4% strongly agreed. When the participants were asked if they would have left teaching if it were not for their participation in the Texas Regional Collaboratives program, 51.8% strongly disagreed, 18.5% disagreed, 25.9% were neutral, 1.9% agreed, and 1.9% strongly agreed. These findings show a definite relationship between the sustained professional development program and science teacher renewal, but the relationship between retention is not as clear.

Discussion

Why would a provider of science professional development be interested in the kinds of teachers attracted to a sustained professional development program and their reasons for joining, remaining and leaving that program? What does this information reveal about science teacher renewal and retention? This information provides valuable information concerning the kind of teacher who seeks professional development opportunities outside of their school districts. In Texas, there are over 282,000 teachers (TEA, 2003). With a teaching population so large, the state has a very diverse teaching pool with diverse needs. When the demographics of the Texas Regional Collaborative teachers is compared to the general demographics of teachers in Texas, the teachers who are participating in the Texas Regional Collaborative professional development program are no different than those in Texas in general. The TRC program attracts the "typical" Texas schoolteacher. This indicates that the kind of teacher attracted to a sustained professional development program is the average teacher who teachers in the typical school. The TRC program does attract outliers, teachers who teach in upper income schools, both female and male, of many different ethnicities and those who have advanced degrees. In general, the

teachers participating in the TRC program are very reflective of the teachers found in any Texas school on any given day.

Why Teachers Join

It is safe to assume that teachers engaged in sustained professional development programs, such as the Texas Regional Collaborative program, are not having their professional development needs met by their local school district. If the school district were meeting their needs, why would they look elsewhere? Teachers in the TRC commit 105 contact hours to the program in addition to their commitment to their school district contract, their family and other personal commitments. When looking at the reasons why teachers joined the Texas Regional Collaboratives professional development program, the top four responses provided by the teachers all focused on improving their practice as teachers. Teachers joined the TRC program to find ways to become a better teacher. They want to learn new pedagogy to assist in student understanding of science content. They are looking for new ways to teach science to their students.

At a more personal level, teachers also want to improve their own knowledge and understanding of science content. Science content changes everyday and the TRC teachers recognize the importance of staying current in the field of science. The TRC also provides them with a support system of other teachers who are actively engaged in improving their practice. Teachers view the Texas Regional Collaboratives as a learning community committed to high standards of science teaching that encourages them to excel. It is through a sustained professional development program, one with a clearly defined vision, that a teacher can grow professionally and meet their need to improve their practice as teachers.

The remaining reasons for joining the Texas Regional Collaboratives professional development program were more extrinsic. Obtaining equipment for their classrooms and obtaining professional development hours are both tangible items teachers can take back to their schools and show their principals. Those reasons, while not directly aiding a teacher in professional growth, are important for many teachers, especially those from rural areas of Texas where lack of funding and opportunities make it hard for teachers to purchase equipment and obtain professional development hours.

For those teachers who cited that they joined because others recommended the program, it was usually because their principal told them they must participate in the Texas Regional Collaboratives and they had no choice in the matter. It was ranked last because it applies to very few of the teachers but it is still an issue to be remembered by professional development providers. There are many teachers involved in professional

development programs that are present against their will and resent their forced participation in the program. One can hope that the experience of the sustained professional development program is a positive one that can overcome the negative attitudes of these teachers.

Why Teachers Remain

Some of the most interesting conversations about experiences in the Texas Regional Collaboratives professional development program were those with teachers who have been in the program for many years. These teachers are the ones who keep coming back year after year and are commonly referred to as the "die-hard" collaborative teachers. When the reasons these returning teachers cite for coming back to the program are examined, it is found that the majority of the reasons are intrinsic. These teachers return because they learn new ways to teach science in their classrooms. These returning teachers have support systems in the collaboratives that constantly engage them in professional dialog that are not found in their school districts. The networking is extremely valuable for the teachers in rural school districts where the collaborative teacher may be the only science teacher in the district. They use the collaborative as a place to turn for support and help when they have nowhere else to turn. In addition, the friendships they create through their participation in the collaboratives are important to many of the teachers and are one reason that many teachers return year after year.

The networking has also impacted the returning teachers by enabling them to stay current on statewide educational issues. Texas is nationally known for it's high stakes testing. Beginning in 2003, science will be an "accountable" tested area for the first time. Texas Regional Collaboratives teachers cite that through their participation in the TRC program, their information on the new science test is current and they feel well prepared for the test. Having access to this knowledge and information is one reason they keep coming back year after year. Finally, they do receive professional development credit that fulfills certain requirements of their school district.

Why Teachers Leave

If the Texas Regional Collaboratives professional development program is so beneficial why do teachers leave the program? Most of the reasons cited for leaving the TRC program are related to the program having a negative impact on some other part of the teacher's life. For example, the number one reason cited for leaving the program was family reasons. Many teachers reported that they left the program because they had to take care of an elderly parent or they had a baby and the TRC program would not allow them to both participate fully in it and fulfill their family responsibilities. The second reason cited, amount of time involved, is related to the first reason. Many teachers stated that the TRC program just took too much time from their personal life and/or time away from

their classroom. The teachers felt they could not provide for both their students/family and to the collaborative due to the time commitment involved. One hundred five contact hours, in addition to a normal workday, is a large time commitment for anyone, especially someone teaching full time, who has a family since the collaborative meets after school and on weekends. In addition to the time commitment, many collaboratives offer graduate credit as part of the membership in the collaborative. When the workload of assignments related to graduate coursework is added to the time involved with the collaborative, it is too much to handle for many teachers.

The remaining reasons teachers provided for leaving the collaborative were not related to time or workload. Many teachers are no longer in the TRC program because their teaching assignments had changed and they are no longer teaching science or had moved into other school positions such as assistant principal, principal or school counselor. It is discouraging to find that after receiving sustained professional development in science, many teachers have their teaching assignments changed and they are no longer teaching science. On the other hand, learning that highly trained science professionals are now serving in leadership roles at the local campus level is very encouraging. These are individuals who have moved into decision-making roles, such as principals and assistant principals, who are knowledge about science and understand the costs of having a quality science program. In addition, a counselor with a science background is more likely to encourage ALL students, not just those students who are college bound, to enroll in upper level science and math courses.

As with any program, where more than two people are brought together, personality conflicts are bound to arise among the participants and leaders of the program. The last reason that teachers cited for leaving the program was personality conflicts with others in the collaboratives. Such conflicts are an unfortunate side effect of working with large groups of people. This is an important issue for professional development providers to consider when designing programs and training leaders of the programs. Recognizing personality differences and conflict management should be incorporated into the training to help leaders deal with any problems that may arise.

Factors Impacting Science Teacher Renewal

Conversations with Texas Regional Collaboratives' teachers are always stimulating experiences. TRC teachers are more than willing to discuss the impact of the TRC program on them as teachers, especially in the area of their renewal. Building confidence in the teaching ability of the individual was the most surprising factor impacting science teacher renewal. TRC teachers did not overtly discuss how the program has boosted their confidence during conversations. When the teachers' responses to the open-ended questions are considered and

when careful examination of the transcribed interviews is conducted, however, it becomes evident that the program plays an important role in building confidence in their teaching ability.

Many science teachers come to the program already feeling confident in their science content knowledge but not in their ability to teach science. Through the sustained professional development program of the TRC, these teachers develop confidence in their teaching ability as well. For example, one teacher, commented, "The collaborative made the most impact with me in how I teach science. It taught me how to TEACH science." Another, a second teacher declared, "It has given me a sense of accomplishment and the ability to be a successful teacher." These teachers are reflective of numerous others in the program. How does this impact their renewal as teachers? Since they have greater confidence in their teaching ability, Texas Regional Collaboratives teachers do not worry about the teaching decisions they make in their classrooms. A teacher stated, " I felt pretty solid in my science background however I have grown in my knowledge (of) teaching methods and learning pedagogy." TRC teachers know that they have been trained in sound pedagogical content and are confident that they are teaching their students in ways that are consistent with current research in knowing and learning.

The second factor impacting science teacher renewal is that the sustained professional development program provides networking opportunities for the teacher participants. The networking aspect of the TRC program is what the teacher participants, both returning and non-returning teachers, highlight the most in their conversations about the program. It "...gave me opportunities to meet knowledge people who have helped me become a better teacher," stated one interviewee. Having the support system of teachers, scientists and science educators in their local community is vital to their renewal in the profession. TRC teachers have access to scientists in their local communities to assist them in understanding complex science concepts. Many collaborative teachers have invited these scientists into their classrooms to share their research and to make science more "real world" to their students.

In addition to networking with local scientists, Texas Regional Collaboratives teachers also consider the networking and support system created among each other to be important. As one teacher stated, "The TRC has provided an incredible network of other science teachers for me to call on for support." Teachers of the Texas Regional Collaboratives program have outside support of others as they face the day-to-day struggles of their classroom, an especially valuable asset for the teachers in the rural parts of the state. They have the support of at least twenty other teachers in their region and hundreds statewide to supply assistance when needed. As one such teacher commented, "I am from a small school where I am the only science teacher so I get ideas and help from

other teachers in my same situation." This networking and support system created by the Texas Regional Collaboratives is especially critical to those teachers, who lack resources and support in their school districts. This networking and support system renews them and keeps them interested in science teaching.

Creating professional environments is a third way the Texas Regional Collaboratives professional development program impacts science teacher renewal. Through its Annual Meeting and Honoring the Teachers events, the Texas Regional Collaboratives values the hard work and dedication of its' teachers and treasures the teacher participants. As a result of the leveraging of the Texas Regional Collaboratives program, the teacher participants have access to TRC specific grants and awards. "Feeling part of a greater, statewide collegial group of professionals dedicated to the highest standards of science education" is what one teacher described as how the program impacted her and her view of teaching. The TRC program honors her in ways that her school and school district do not. Knowing that she is not alone in trying to be a better science teacher, but that there are other teachers in her local area and across the state striving to do the same sustains her in the profession. A 9th grade teacher confirms this belief. "So when you go to the collaboratives, we're all on the same page. We have commonalities and so that makes the staff development better for me because we kind of have similar visions...we want to be there." The Texas Regional Collaboratives treats its teachers, as the literature on retention recommends (Cockburn, 2000; Cohen, Higgins, & Ambrose, 1999; & Hancock, 1998), as professionals and values the work that they do.

Providing leadership opportunities is another factor impacting science teacher renewal. The professional development events provided by the Texas Regional Collaboratives allow teachers to develop leadership. As stated earlier, a principle of an effective professional development program is that it places teachers in leadership roles. By becoming Instructional Team Members and Science Teacher Mentors, teachers take on leadership roles within their collaborative. A 7th grade teacher stated, "The TRC enabled me to participate in many leadership opportunities that are not readily available to new teachers. I have received valuable information from other teachers around the state." These opportunities develop teachers to their full potential and others outside of the collaborative often take notice. For example, one teacher stated, "Through my experiences in the collaborative, I will hold a leadership position as the Science Coordinator for Elementary Science". Her school district recognized her and the abilities she developed through the collaboratives and she will now have the opportunity to work with and mold the elementary science program of her school district. Another teacher confirms this sentiment. "The greatest impact of the TRC is that it allowed me to take a leadership role in my district and throughout the state." Many collaborative

teachers serve on state level committees; assist in science textbook adoption, and in the writing of the new Texas Assessment of Knowledge and Skills (TAKS) in Science. Instead of being confined to the routine of their classroom, they are provided with leadership experiences outside of their school, thus providing them a fresh view of the educational system.

For most teachers in Texas, the new state accountability test in science is of great concern. For the teachers of the Texas Regional Collaboratives, the anxiety level about the TAKS test is lowered due to their participation in the TRC program. Providing current information on statewide education issues is the fifth factor impacting science teacher renewal. As a high school teacher stated, "I feel confident my students are going to (be) successful on the Texas Assessment of Knowledge and Skills because we have been prepared for it through the collaboratives for the last couple of years." Many TRC teachers share these feelings. Not only do they know their students will perform well on the TAKS test, but they do not worry about their performance on their year-end evaluation either. A portion of a teacher's evaluation each year is determined by how their students' perform on the statewide accountability test. TRC teachers do not worry about this part of their evaluation because they are well prepared through the collaborative training. "Discussing the Texas Essential Knowledge and Skills (the state standards) and how we feel our teaching will prepare us for the new science test" is just one way another teacher described how the collaborative keeps stress levels down regarding the TAKS test. TRC teachers have lower concerns on the statewide test because of the information they receive. As many stated, TRC participation gives teachers an advantage, it keeps them aware so they feel prepared for the new statewide test and all the changes that accompany it.

Finally, sustained professional development impacts science teacher renewal by providing classroom materials and lessons to its teachers. This finding is probably the most obvious of the six factors but is also one of the most important for collaborative teachers. Many of the collaborative teachers work in rural schools where resources are very limited. Through their participation in the Texas Regional Collaboratives program, they have access to Cambridge Physics Outlet (CPO) kits, Full Option Science System (FOSS) kits, digital cameras, graphing calculators and data collectors. All of these are materials that rural teachers could never afford. One such teacher stated, "We use equipment and technology that my school can't afford. We are invited to borrow these items and use them in our classrooms." Having access to these materials makes teaching science invigorating, allowing TRC teachers to try relevant and up-to-date science experiments with their students.

In addition to classroom materials, the TRC provides a vast library of lessons for teachers to take back to their classrooms. Many mid-career teachers get caught in a rut, teaching the same lessons year after year, making their teaching experience less than exciting or cutting edge. This does not happen to TRC teachers. "I have obtained a vast library of materials from which I can choose and use in my classroom, " stated one teacher. Some teachers reported having binders full of standards-based lessons that they had collected during the years in the Texas Regional Collaborative program. Some of the non-returning teachers reported that they left the program because they had so many lessons and ideas that they wanted to try in their classroom and they needed time to "digest" all of the materials before returning to the program. How can a teacher fail to be renewed in their profession when they have a source for classroom materials and lessons available to them?

Conclusions

Teachers involved in sustained professional development programs, such as the Texas Regional Collaboratives for Excellence in Science Teaching, are demographically no different from other teachers found in the state of Texas and in most regards nationally. Taking the demographic information into account in conjunction with reasons why teachers join, remain, and leave professional development programs, professional development providers can create some outstanding opportunities for science teachers.

We know that teachers join the TRC program to improve their practice. They are searching for ways to become better teachers. We also know that teachers stay in the TRC program because of the intrinsic value they receive from the professional development. They benefit from the networking opportunities, the classroom lessons and activities, and staying abreast of statewide changes in education. These reasons correlate with their desire to renew their practice as science teachers. Most of these teachers were mid-career teachers who were tired of how they were teaching. Why else would they want to improve their practice? It is through a sustained professional development program, such as the Texas Regional Collaboratives, that these mid-career teachers were able to renew their interest in science teaching. They see teaching in a new light. The TRC program has provided them with the confidence they need to feel accomplished, professional teachers. They leave the professional development program with new ideas and teaching strategies to meet the needs of ever-changing classrooms. They are armed with appropriate pedagogy, content, and lessons and have a network of other teachers in their local area who are trying to do the same thing in their classrooms. The TRC teachers are put in leadership roles in and across the state that challenge them and keep the world of science teaching magical to them.

From those teachers who have left the Texas Regional Collaboratives program we have learned that the time commitment of 105 contact hours is a negative. This is consistent with the literature on barriers to professional development (Caffarella & Zinn, 1999; Hancock, 1998; & Duke, 1993). Although family reasons was the primary one teachers cited for leaving, time is a major factor in a teachers' decision to leave a sustained professional development program. The 105 contact hours take teachers away from their family, friends and their students. When asked if they could change one thing about the Texas Regional Collaboratives program, most teachers responded that they would want less time involved and many of the non-returning teachers said they would return to the program if it involved less of their time. Investigation of the optimal contact hour time for an effective collaborative is beginning. Research on effective professional development (Garet et. al, 2001; Rhoton & Bowers, 2001; Loucks-Horsley, et.al, 1998; NSES, 1996) states that the professional development must be sustained for it to be effective. The question of optimal contact time for sustained professional development remains to be investigated.

Although the data did not reveal a strong relationship between the Texas Regional Collaboratives professional development program and science teacher retention, the foundation for that partnership is laid. When the literature on why teachers leave the profession and how to retain teachers is reviewed and compare that to the impact of the Texas Regional Collaborative on science teacher renewal, the connection to retention is obvious. Teachers leave the profession because they are not treated like professionals (Cockburn, 2000; Cohen, Higgins, & Ambrose, 1999; & Hancock, 1998) and they do not have a support network of other teachers to assist them with the struggles of daily teaching (Luft & Cox, 2001; Olsen, 2000; Hancock, 1998; & Bullock & Scott, 1993). Creating professional environments for teachers and providing networking opportunities are two important factors of renewal uncovered in this study.

The literature also reports: providing appropriate materials (Olsen, 2000; & Cohen, Higgins, & Ambrose, 1999); support systems (Luft & Cox, 2001; Olsen, 2000; Hancock, 1998; & Bullock & Scott, 1993) and sustained professional development (Rhoton & Bowers, 2003; & Loucks-Horsley, et.al, 1998) as ways to retain teachers. The Texas Regional Collaboratives professional development program supplies these. The TRC provides classroom materials and lessons that allows teachers to teach science the way it is called for in both state and national standards. The program supplies intensive networking and support systems for its teachers while providing effective sustained professional development.

Investigation of why the survey did not show a direct relationship between professional development and retention is of interest. It could have been the teachers sampled. Of the twenty collaborative sites, six were used for this study. If the survey had utilized all participants of the collaborative program, findings could be different. For the mid-career teachers with 13.4 years of teaching experience involved in the study, retention may not be an issue. They are career teachers whose main concern is renewal. A different sample of Texas Regional Collaborative teachers, especially those in their first five years of teaching, might provide a link between professional development and retention.

It is believed that effective professional development is still the key to solving the science teacher renewal and retention problem. Professional development arms teachers with the skills and knowledge they need to be successful teachers. It provides teachers with the most current and up to date research in both science and in pedagogy, which can make teachers more effective in the classroom. In a study by Yager, Hidayat, and Penick (1988), it was found that professional development was one of the indicators of an effective science teacher. 64% of the teachers who were identified as "effective science teachers" attended more than five professional development activities over a five-year period. In comparison, 62% of the less effective science teachers attended one or fewer professional development activities over the same five-year period. Lack of professional development is cited as a reason that teachers leave the profession (Hancock, 1998). If we provide teachers with effective professional development then they will be more likely to stay in the profession because the development will address critical issues that are relevant and important to teachers.

The Texas Regional Collaboratives for Excellence in Science Teaching is an effective science teacher professional development model that meets the requirements of research, the stakeholders, and most importantly of the teacher participants. There are numerous other research areas under investigation at the Texas Regional Collaboratives office. Further study on the role of professional development on science teacher retention and renewal as well as the impact of the professional development on student achievement is under investigation. The TRC model of professional development is a replicable model for other states to use if one is considering creating a sustained professional development program. It is considered an effective model and meets the needs of diverse groups of teachers. By understanding why teachers join a program, such as the Texas Regional Collaboratives, and the needs these programs meet, teacher educators and professional development providers can gain some insight to the needs of practicing teachers and develop new opportunities that will enhance teacher job satisfaction and teacher retention rates.

Appendix A

Texas Regional Collaboratives for Excellence in Science Teaching Demographic Data

Gender	
Male	Female
17%	83%

Type of Certification	
Traditional	Alternative
83%	17%

Ethnicity					
White	African-American	Hispanic	Asian-American	Native American	Other
72.5%	5.7%	18.1%	.9%	1.0%	1.8%

Highest Degree Held		
Bachelors	Masters	Doctorate
76%	23.3%	.7%

Receive Title 1 Funds	
Yes	No
72%	28%

Teaching Level		
Elementary	Secondary	Other
49%	45%	6%

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Organization/Address: The University of Texas at Austin, 1 University Station, D5500 Austin, TX 78712-0377	Telephone: 512-471-9400	FAX: 512-471-9241 4
	E-Mail Address: jmeyer@mail.utexas.edu	Date: 3-25-03